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United States Department of Agriculture | Forest Service | Forest Pest Management | 55 So. Sacramento Street Susanville, CA 96130 530-257-2151 VOICE 530-257-6244 TTY

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Subject: Entomological input to the Oak Flat and Quartz Point Areas, Downieville RD, Tahoe NF (Report # NE97-13)

To: District Ranger, Downieville RD, Tahoe NF

At the request of District personnel, I visited several stands in the Oak Flat and Quartz Point (T18N R10E Sec. 3,4,9,10) areas on October 8, 1997. The objectives of the visit were to determine the cause of the ponderosa pine mortality apparent in some stands and to provide some management alternatives to reduce future mortality to acceptable levels.

Bark and engraver beetle-related mortality occurs primarily in "groups" of trees with the pine bark beetles, primarily due to their pheromone system, or as single trees scattered over several acres with the fir engraver. Successful attacks by the pine bark beetles (western, mountain and Jeffrey pine beetles) result in tree mortality. Successful attacks by the fir engraver (in red and white fir) can result in top-kill, branch kill, patch kills along the bole and/or whole tree mortality. In general, mortality occurs in overstocked stands, however during periods of protracted drought, mortality may be expected to occur throughout various stocking regimes. Effects resulting from bark beetles may include the following: direct tree mortality, openings that vary in size, less trees/acre, reduced canopy closure, increase in standing dead and down woody material, increase in fuel load, increase in decomposition and nutrient cycling, increase species diversity/decrease species diversity, increase in snags and cavity nesting opportunities and a change in species composition.

The importance or significance of these effects depends on their severity and extent and ultimately how they affect (positively and/or negatively) ecosystem structure and function (desired condition) and specific management goals and objectives.

Stand 105 - Species composition in this stand is dominated by ponderosa pine, white fir and Douglas fir. Incense cedar is a lesser component. The overstory is mainly ponderosa pine with the other species being more dominant in the smaller size classes. The total number of trees per acre in this stand is 523 and the basal area is 308 sq. ft./acre. Western pine beetle, Dendroctonus brevicomis, -related mortality in several size classes was apparent throughout this stand. Based on the condition of the standing dead trees and those on the ground, mortality has been occurring in these stands for several years. The mortality pattern did not seem to indicate a large outbreak of western pine beetle in a single year, typical during protracted

drought periods, rather, the mortality pattern indicated a chronic level of bark beetle activity associated with the stand conditions.

Stand 110 - This stand is also a mixed conifer stand that is dominated by pine in the overstory with a mix of white fir, incense cedar and Douglas fir in the understory. There are 253 trees per acre and 235 sq. ft./ acre of basal area. Western pine beetle-related mortality was apparent in this stand as well.

Stand 135 - This is small ponderosa pine stand with about 100 trees per acre and a basal area of 180 sq. ft./acre. No mortality was detected in this stand.

Stand 140 - Stand 140 is 8 acres with 168 trees per acre and 244 sq. ft./acre of basal area. The stand is comprised of ponderosa pine greater than 9 in. dbh and Douglas fir (< 5 in dbh). Western pine beetle activity is apparent in the ponderosa pine.

Stands 145 & 150 - Stand 145 is 10 acres of ponderosa pine and incense cedar. All ponderosa pine are greater than 15 in. dbh and the incense cedar are mostly < 9 in. dbh. Species composition is dominated (81%) by the incense cedar in the understory. There are 180 trees per acres and 123 sq. ft./acre of basal area. Stand 150 is 47 acres of ponderosa pine and incense cedar. All incense cedar are less than 3 in dbh. The dbh's of the pines range from 3 to 41 inches. Species composition in dominated by ponderosa pine (90%). There are 162 trees per acres and 235 sq. ft./acre of basal area. There are small pockets of ponderosa pine mortality in these stand associated with attacks by western pine beetle.

Stand 85 - This stand is dominated by Douglas fir (71%) with lessor components of sugar pine, incense cedar, white fir and ponderosa pine. There are 270 trees per acre and 270 sq. ft./acre of basal area. In this stand, natural thinning will occur as suppressed trees are shaded out and die.

Discussion

The majority of the ponderosa pine in this stand are in the size classes (>8 in dbh.) that are susceptible to western pine beetle attacks. Although west side stands are often able to handle higher stocking levels, compared to drier east side stands, the outcome of trying to carry higher amounts of basal area is often the loss of the ponderosa pine in the overstory. In this stand the understory is comprised of species that are growing vigorously under the current conditions and perhaps even more important, they are species that are either less susceptible to bark beetle attacks or are attacked by beetles that do not tend to be as aggressive as the Dendroctonus species.

Direct tree mortality as a result on insect attack is not common in incense cedar. The bark beetles, Phloeosinus sp., and wood borers that attack incense cedar are not considered to be aggressive tree killers however their impact, combined with drought stress can cause mortality. The Douglas fir that occurs in this area is not often impacted by insects and/or pathogens typical of more coastal areas. Flatheaded fir borer, Melanophila drummondi, and black stain root disease, Leptographium wageneri are commonly associated with decline of Douglas fir, however the detected incidence of black stain root disease in

Douglas-fir in the Sierra Nevada is quite low. Extended drought periods in concert with attacks by the flatheaded fir borer may cause an increase level in Douglas fir mortality.

The fir engraver, Scolytus ventralis, is the most important bark beetle attacking white fir in this area. There does not seem to be a recognizable pattern of fir engraver outbreaks in California. Under adequate moisture regimes, overstocking of fir stands and high infection rates by root disease are the principal factors involved in predisposing trees to attack by fir engraver. Populations of less aggressive species like fir engraver are likely to wax and wane in direct relationship to the stresses of their hosts. Drought conditions often result in widespread fir mortality; however, attempting to determine when outbreaks will occur is difficult. Lowered resistance of trees appears to be a contributing factor. Overstocking and the increased presence of fir on sites that were once dominated pine species may also contribute to higher than normal levels of fir mortality. Therefore, on the west side of the Sierra Nevada most fir engraver-related mortality occurs during protracted drought periods when there is an ample supply of host material available over a period of several seasons or in overstocked stands where a chronic level of mortality is apparent even during normal precipitation years.

Based on the above information, and an understanding of the current stand conditions and species composition by size classes, it becomes apparent why the mortality is primarily occurring in the ponderosa pine. The older, larger ponderosa pine trees are competing with a young, vigorous, shade tolerant understory for a finite amount of moisture and nutrients. This, coupled with the fact that western pine beetle is the most aggressive bark beetle operating in these stands, suggests that if maintenance of the overstory pine is a management objective then stand conditions need to be altered to lower the pine's susceptibility to bark beetles.

Mortality should be expected to be exacerbated in areas where soils tend to be shallow and sandy, particularly during protracted drought periods in overstocked stands. Soil type should be a key factor in determining the appropriate stocking density and desired species mix of the residual trees. Ponderosa pine, a more drought tolerate species, should be favored on drier, droughty sites. Incense cedar is also well adapted to handle dry conditions. Deeper soils would tend to favor incense cedar over more shallow soils. It often grows more slowly than associated conifers and is therefore, typically a component of the intermediate and suppressed crown classes. Although dry, droughty sites may be capable of growing such species as white fir and Douglas-fir, it is not likely that these soils can sustain these species long enough to get them to the larger size classes, particularly during protracted drought periods. Douglas fir grows better on well drained, deep soils, rather than those that are poorly drained and have an impervious layer near the surface. White fir is found on a variety of soils developed from almost every kind of parent material. It is generally tolerant of a wide range of soil conditions, nutrient availability and pH values. It seems to be more dependent on moisture availability and temperature than on soil series. If maintenance of drought-intolerant species is desired, stocking densities should be adjusted to reflect this. A mix of trees species and ages, maintained within appropriate stocking levels, will likely result in retaining

some trees during periods of stress or during periods of elevated bark beetle activity.

Risk of Dendroctonus-related mortality

Based on the average diameter of the ponderosa pine in the stands, the total basal area of all species and the per cent of basal area composed of ponderosa pine (all trees > 8 in. dbh), the stands would be rated as follows for western pine beetle-related mortality:

Stand	Risk
105	High
110	Moderate
135	High
140	High
145	Moderate
150	High
85	Very low

* Moratlity levels should be expected to be higher during drought periods.

Desired Condition

The desired state of forest health is the condition where biotic and abiotic influences do not threaten resource management objectives and provide desired, sustainable ecosystems. In part, a healthy forest is one is which the environmental effects of insects and pathogens are maintained within acceptable limits and do not result in unacceptable impacts on the sustainability of the ecosystem structure and function or specific resource management goals and objectives.

Dependent upon management objectives, the acceptable level of insect and pathogen-related activity may vary greatly.

Management Alternatives

(1) No action - Overstocked stands in general will tend to have higher levels of bark and engraver beetle-related mortality. The basal areas in stands will continue to increase as the trees grow. Periodic droughts in California increase the probability that some of the overstocked stands will be attacked by bark beetles. Although some mortality may be desired for snags, small openings and for future down woody debris, the no action alternative will most likely result in unacceptable levels of ponderosa pine mortality. Mortality levels will typically be above background levels as stand density increases, and this affect will be accentuated during periods of below normal precipitation. Similar to the current situation, selection of the no action alternative will continue to result in the loss of the overstory pine and thus, promote an understory of Douglas fir, incense cedar and white fir.

The direct result of an increase in tree mortality is the increase of standing dead (snags) and down woody material. This may result in; a continuing desire to enter stands to conduct salvage operations, an increase in fuel loading,

fewer large, older trees and fewer of the mid-diameter trees that represent the pool from which the large trees and snags of the future come from, a short term increase in nutrient cycling and an increase in the number of hazard trees.

(2) Salvage - Salvage sales can minimize the economic loss and reduce the amount of dead fuel, however these operations will have no effect in reducing or controlling bark beetle populations. At the present time, there are no biologically effective or economically efficient methods available to reduce western pine beetle populations on an area-wide basis under current California conditions such that tree mortality will be reduced to acceptable levels. As a general rule, during periods of above normal tree stress, it is recommended that logging, thinning and timber stand improvement work be minimized as much as possible to reduce the potential for additional stress. Where such activities must occur, extra care should be taken to prevent damage to residual trees.

(3) Thinning Overstocked Stands - Management activities that promote tree health and vigor also reduce the susceptibility to successful bark beetle attack. Increased tree health and vigor is not usually an immediate response. In the short term, thinning stands places an additional stress on the trees, similar to other management activities. Therefore, thinning during non-drought periods would be advocated rather than waiting until mortality is detected. Thinning is perhaps the most critical silvicultural treatment available to restore tree health. Thinning the stands that are at moderate and high risk should promote the health and vigor of the overstory ponderosa pine and reduce their susceptibility to bark beetle attack, reduce flammable fuels, and create growing space for the residual trees.

Silvicultural prescriptions designed to reduce basal area and select for species and stand structure diversity, should result in lower levels of bark beetle-related mortality in the future. Reduce mortality would also have the effect of a reduction in the occurrence of understocked areas that would have low canopy closure. Mortality would continue to occur and fluctuate in response to the amount of available moisture, but at levels that, through time, would more closely approximate naturally occurring mortality. Thinning would result in: a decrease in the need to enter stands to conduct salvage operations; a decrease in the amount of fuel loading and a reduction in the number of hazard trees.

Snags, down woody material and nutrient cycling would occur at more natural levels. The improved growing conditions should result in reduced mortality of large diameter trees and an increase in mid-diameter trees available to grow into large diameter classes. Selecting for a some diversity of residual tree species during thinning is desired as bark beetles are fairly host-specific and diversity should guarantee that some trees will remain alive during elevated stress periods.

(4) Insect Prevention (Chemical) - There are registered insecticides for pine bark beetle prevention that are effective in preventing bark beetle attacks. This is a prevention treatment, in that the insecticide needs to be applied prior to a tree becoming infested with bark beetles. If a tree is already infested, this treatment would not be successful in saving the tree. Typically this treatment has been used for high value trees such as those in

campgrounds or around administrative sites or for protecting identified rust resistant sugar pine trees.

Conclusion

Implementation of alternatives 2 and 3, combined with vegetation restoration activities in the large mortality centers will most likely result in obtaining and maintaining the management goals and objectives for this area. Objectives to be considered may include restoring the resistance and resilience to natural stresses, decreasing the risk of catastrophic fires, and modifying the vegetation to reduce potential damages caused by insects and diseases.

If you have any questions regarding this evaluation or need additional assistance please call me at 530-252-6667.

Sheri Lee Smith
Entomologist
NE CA Shared Service Area